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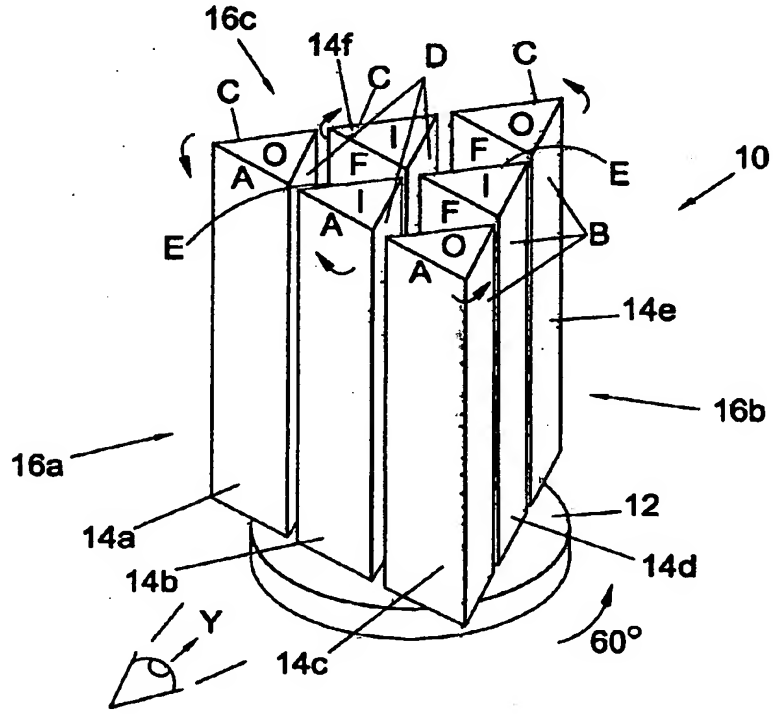

(57) Abstract: There is disclosed a three dimensional display device (10) comprising a support member in the form of a rotatable plate (12), a plurality of display elements in the form of prisms (14) and drive means (11) for moving the prisms (14) between at least first and second display positions. In one embodiment of the invention, the display device (10) includes six prisms (14a-14f) together defining six display surfaces (16a-16f), each display surface presenting a visible display. In use, at least two display surfaces are visible and the drive means (11) moves the display elements (14a-14f) to change the display surfaces which are visible.

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DISPLAY DEVICE

The present invention relates to a display device. In particular, but not exclusively, the present invention relates to a display device defining a plurality of display surfaces.

Many areas with large transient or captive audiences, such as airport and ferry terminals, railway stations and ferries, require highly economical methods of advertising. In this field, there is a continuous demand for innovation by product manufacturers in relation to displays for luxury goods.

The benefit of the use of movement to draw the attention is common knowledge in this context, and devices with moving displays have been developed. A typical such display device is the two-dimensional (2D) billboard type display. The billboard includes a plurality of, typically, three sided display elements. These display elements are rotatable between rest positions, where only one side of each display element is visible. These visible sides together define a visible display surface of the billboard, providing a corresponding display. Accordingly, the three sides of the display elements together define three separate displays, which may be viewed in turn on the front of the billboard by rotation of the display elements. The problems associated with such devices are that only a single display is visible at any one time. In addition, a relatively small number of displays is visible in sequence.

Alternative types of display device include three-dimensional (3D) type displays, which typically comprise a single display element which defines a number of displays on, usually, three or four separate display surfaces. The display element is rotated to progressively allow each display to be viewed from any location. Problems associated with this type of device include that the number of visible displays is limited by the

dimensions of the single display element, and the displays on any display surface cannot be alternated.

It is amongst the objects of the present invention to obviate or mitigate at least one of the foregoing disadvantages.

According to a first aspect of the present invention, there is provided a three dimensional display device comprising:
a support member;
a plurality of display elements coupled to the support member, the display elements together defining a plurality of display surfaces, each display surface presenting a visible display in use; and
drive means for moving the display elements between at least first and second display positions;
whereby, in use, at least two display surfaces are visible, and whereby the drive means moves the display elements to change the display surfaces which are visible.

In another aspect the present invention provides a display device comprising:
a support member; and
a plurality of display elements mounted on the support member, the display elements being rotatable between a first display position, where the display elements define a first set of at least three visible display surfaces, and at least a second display position, where the display elements define a second set of at least three visible display surfaces and means for translating the display elements between said first and second positions.

The first and second sets of visible display surfaces are preferably independent, such that only one of the first and second sets is visible when the display elements are in their respective first and second positions. Advantageously, this

allows at least six display surfaces to be selectively defined by a single display device.

Furthermore, this allows a series of at least six display surfaces to be viewed from a single location. Thus, it will be understood that two sets of at least three, optionally different, displays may be viewed on a single device. Further, a series of at least six, optionally different, displays may be viewed in sequence on a single display surface.

It will be understood that any desired display may be presented on or in the display surface, for example, moving or stationary text, images or the like, or actual products. The display elements may together define a combined display on each display surface, or may each define a separate, independent display on each display surface of which they form part.

Preferably, each display element includes at least three display faces. The display device may comprise an even number of display elements, and in particular may comprise six display elements, which together define the first and second sets of at least three display surfaces. Alternatively, the display device may comprise eight display elements, together defining first and second sets of at least four display surfaces, ten display elements together defining first and second sets of at least five display surfaces, or more. In further alternatives, the display device may comprise an odd number of display elements.

The display device may comprise a first group and at least a second group of display elements, each group comprising at least three display elements. One of the groups of display elements may be rotatable between the first and second display

positions in an opposite direction to the other group. Conveniently, each display element is coupled to the support member by a pivot, in particular an offset pivot coupled to the display element off centre from a main axis of the display element. The display elements may each comprise a generally elongate column, such as a triangular prism. Alternatively, the display elements may be of any other alternative suitable prism, for example, a square or rectangular prism, or indeed any other suitable shape. In a particular further alternative, the display elements may taper along a main length thereof to form tapered columns.

The support member may define a lower support such as a base plate, with the display elements mounted on the lower support, or may define an upper support member such as an upper plate, with the display elements suspended therefrom. Preferably however, the display device further comprises first and second support members, one of the first and second support members forming an upper support and the other one of the first and second members a lower support, with the display elements rotatably mounted therebetween. The or one of the first and second support members may comprise a rotatable plate. Alternatively the device may be orientated on its side, whereby said display elements are mounted horizontally instead of vertically.

The support member or one of the support members may be rotatable and may form part of the drive means. Conveniently, the drive means further comprises a gear mechanism, and the drive means, in particular the gear mechanism, may be adapted to rotate selected ones of the display elements in opposite directions to the remainder of the display elements. In particular, the gear mechanism may be adapted to rotate the first and second groups of display elements in respective opposite directions.

The gear mechanism may comprise a gear coupled to each display element, and the display element gears may be intermeshed, such that rotation of a selected one of the display members rotates all of the display elements. The gears may be intermeshed such that any one display element rotates in an opposite direction from the or each adjacent display element. The gear of each display element may be coupled to the display element at the end adjacent the support member. Advantageously, where an even number of display elements are provided, the desired rotation of the display elements may be achieved by simply locating the display elements adjacent to one another, with the respective gears intermeshed.

Preferably, the support member is rotatable such that rotation of the support member may in turn rotate the display elements coupled thereto. The gear mechanism may include a drive connection assembly coupled between the support member and, preferably, one of the display elements. In particular, the drive connection assembly may be coupled to one display element, such that rotation of the support member rotates the one of the display elements through the drive connection assembly, to in turn rotate all of the display elements through the intermeshed gears.

Preferably, the drive means further comprises a fixed gear to which the support member is rotatably coupled and a planetary gear mounted on the support member for rotation around the fixed gear together with the support member. The gear ratio of the planetary gear to the fixed gear may be 3:1. In other words, the planetary gear may be adapted to rotate three times for every pass around the fixed gear. Alternatively, the gear ratio may be 4:1 or 5:1. The gear ratio may be 3:1 where the display device comprises six display elements; 4:1 where the display device comprises eight display elements; and 5:1 where

the display device comprises ten display elements. Thus, the value of the gear ratio may be dependent upon the number of display elements. The display element to be driven by the drive connection assembly may include a pinion coupled to and rotated by the planetary gear through the drive connection assembly. The drive connection assembly may further comprise a crank, connecting rod and associated gear segment, which may be coupled to the display member pinion for rotation thereof in response to a movement of the planetary gear, crank and connecting rod. Conveniently, the gear segment rotates the pinion, and thus the display element, through approximately 180° between extremes of travel. The drive means may further comprise an adjustment device for adjusting the degree of rotation of the pinion and thus the display element.

Preferably, the drive means is adapted to rotate the display elements at variable rotational velocities. The drive means may be adapted to initially rotate selected ones of the display elements at a rotational velocity greater than adjacent display elements. The drive means may further comprise first and second co-operating gears mounted for rotation about off-centre or eccentric spigots, such as eccentric gears. One of the first and second off-centre gears may be coupled to a respective display element. The other one of the off-centre gears may be adapted for rotation to drive the off-centre gear coupled to the display element, to rotate the display element and may be coupled to a gear of the gear mechanism. The first and second off-centre gears of adjacent display elements may be out of phase. In embodiments of the invention, the elliptical gears may be 180° out of phase.

Alternatively, the drive means is adapted to rotate selected ones of the display elements with a time delay over the remainder of the display elements. In particular, the drive means may rotate one of the first and second groups of display

elements with a time delay with respect to the other one of the first and second groups of display elements. This advantageously ensures that there is no undesired contact between the display elements, and in particular between the display elements of opposite groups, during movement between the first and second display positions.

The drive means may further comprise a lost motion assembly to rotate selected ones of the display elements with a time delay. The lost motion assembly may comprise a lost motion device, preferably one for each display member, coupled between each gear of the gear mechanism and a respective display element, said lost motion device absorbing at least part of the rotational motion of the respective gear at one end of its travel. Advantageously, this allows selected ones, in particular, one of the groups of display elements, to commence rotational movement before the other group of display elements. This may occur at a respective end of the travel of selected ones of the lost motion devices. The or each lost motion device may comprise a spring loaded or otherwise biased lever arm adapted to engage a detent at one end of its rotational travel. The detent may comprise a notch defined by the support member. Conveniently, a notch is provided for each lever arm of the respective lost motion devices. The lever arm may be rotatably mounted on the gear of the gear mechanism and may include a first end having a first face adapted to engage a respective detent and a second end having a second face adapted to abut a restraint. A gap may be provided between the second face and the restraint, the dimensions of said gap defining the degree of lost motion. The restraint may comprise a shoulder on the gear of the gear mechanism, and a spring may be provided between the restraint and the first end of the lever arm, to bias the lever arm into engagement with the detent. It will be understood that a certain amount of the rotational travel of the gear is

absorbed by opening the gap between the second face of the lever arm and the shoulder, this motion being absorbed by compression of the spring.

Further preferred features and advantages of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figs. 1A-1F are schematic perspective views of part of a display device in accordance with a preferred embodiment of the present invention, shown during stages of movement of display elements of the device between first and second display positions;

Fig. 2 is an enlarged schematic top view of the display elements of the display device in the position of Fig. 1A;

Fig. 3 is a top view of part of the display device shown in Figs. 1A-1F, showing a support member and a gear connection mechanism, forming part of a drive means of the device;

Fig. 4 is a top view of part of the display device shown in Figs. 1A-1F, showing gears and a lost motion assembly, forming further parts of the drive means and with the support member and gear connection mechanism of Fig. 3 removed for illustration purposes;

Fig. 5 is a view similar to Fig. 4, but also showing the display members;

Figs. 6A and 6B are a further enlarged view and a side view, respectively, of a lost motion device forming part of the lost motion assembly of Figs. 4 and 5;

Figs. 7A-7C are cross-sectional, top and bottom views of an optional adjustment device, forming part of the gear connection mechanism of Fig. 3;

Fig. 8 is a view similar to Fig. 1A of part of a display device in accordance with an alternative embodiment of the present invention; and

Fig. 9 is a top view of a display device in accordance with a further alternative embodiment of the present invention, similar to the view of Fig. 5; and

Figs. 10 and 11 are schematic top views, similar to the view of Fig. 2, of display devices in accordance with still further alternative embodiments of the present invention.

Referring firstly to Fig. 1A, there is shown a display device indicated generally by reference numeral 10. The display device generally comprises a support member in the form of a rotatable base plate 12, and a number of display elements, in this embodiment, six display elements in the form of triangular columns or prisms 14a-14f, mounted on the base plate 12. The device 10 is typically mounted either at ground level, or at a raised position, within a transparent cylindrical casing (not shown).

Each of the prisms 14a-14f are rotatable between a first display position, where they define a first set of at least three visible display surfaces and at least a second display position, where they define a second set of at least three visible display surfaces. In Fig. 1A, the prisms 14a-14f are shown in a rest position where they are in their respective first positions. In this position they define three visible display surfaces or sides of the device 10, indicated generally by reference numerals 16a, 16b and 16c, respectively.

Each prism 14a-14f includes three display faces, and these are indicated by the letters A-F. A user viewing the visible display surfaces 16a-16c in the direction Y sees a display such as static or moving text, images or pictures, or indeed an actual product or products located in the prisms 14. In Fig. 1A, a user viewing the visible display surface 16a sees a combination image A on the display faces of the prisms 14a-

14c. In a similar fashion, a user viewing either of the visible display surfaces 16b or 16c sees a display B or C, respectively. Accordingly, the prisms 14a-14f, in their first positions of Fig. 1A, define a first set of displays A, B and C.

The second set of displays D, E and F are illustrated in Fig. 1B, where the prisms 14a-14f have rotated in a predetermined fashion to display the second set of visible display surfaces 16d, 16e and 16f. This is achieved in the following fashion. From the rest position of Fig. 1A, the base plate 12 is rotated 60° in the direction of the arrow shown. This rotation causes a first group of prisms including the prisms 14b, 14d and 14f to rotate through 180° in the opposite direction, as indicated by the respective prism arrows. A short time after movement of the prisms 14b, 14d and 14f has commenced, each of the prisms 14a, 14c and 14e commence rotation through 180° in a direction opposite that of the first set of prisms 14b, 14d and 14e.

The combination of the rotation of the base plate 12 and the prisms 14a-14f in this fashion moves each of the prisms to their respective second display positions, such that the displays D, E and F are visible, as discussed above. Accordingly, a user viewing in the direction Y has now viewed, sequentially, first and second displays A and D on display surfaces 16a and 16d.

After a short rest period, the display device 10 is moved a further time, returning the prisms 14a-14f to their first positions of Fig. 1A. However, this movement is achieved by a further rotation of the base plate 12 through 60°, as shown in Fig. 1B. Through a gear mechanism which will be described below, the respective prisms 14a-14f are rotated in the opposite direction from that shown in Fig. 1A, to the

positions of Fig. 1C. This is advantageous in that each of the prisms 14a-14f are never rotated more than 180° in either a clockwise or anti-clockwise direction, to avoid putting strain on any electrical connections or the like extending into the respective prisms.

Thus, as shown in Fig. 1C, a user viewing in the direction Y now sees a display C on display surface 16c. This process is repeated as shown through Figs. 1D-1F until a sequence of six displays A-F, in varied order, has been viewed. For example, viewing in the direction Y, a sequence of displays A, D, C, F, B and E is viewed on corresponding display surfaces 16a, 16d, 16c, 16f, 16b and 16e. A further rotation from the position of Fig. 1F returns the display device to the position of Fig. 1A, and the device 10 has completed a full cycle through the displays.

Turning now to Fig. 2, there is shown an enlarged schematic top view of the display device 10 shown in Figs. 1A-1F, illustrated in the rest position of Fig. 1A. The first set of prisms 14b, 14d and 14f which are pointing towards the centre of the device 10 in the rest position are referred to as "inside columns" (designated I in Fig. 1A), whilst the remaining prisms are referred to as "outside columns" (designated O). As will be understood, during movement of the various prisms between the positions of Figs. 1A-1F, the first and second sets of prisms alternate between inside and outside prism positions.

As shown in Fig. 2, each of the prisms 14 are chamfered at 18 so that the respective prisms do not clash during their movement. The diameter PC of the pitch circle 20 where equally spaced offset pivots 22a-22f are located is shown in Fig. 2. D1 is the diameter of the circle circumscribing the three outer chamfers 18 of the outer prisms in an end

position, whilst D2 is the diameter of the largest possible free circular space provided within the device 10. The relationship between the diameter D1 and D2 is such that D1 + D2 = 2PC.

In addition, W is the width of each display surface 16a-16f; G is the width of the display faces of the left and right side prisms (14a and 14c on the display face 16a for example); H is the width of the centre prism (14b in the display surface 16a, for example); whilst J is the width of the gap between the inner prisms (shown in the "detail" view of Fig. 2). The relationship between these dimensions is such that W = 2G + 2J + H. In addition, Z is the maximum width of the overall display for the particular pitch circle 20. This width Z = PC $\sqrt{3}$. In theory, the dimension J can be reduced to zero, however a manufacturing tolerance is usually required and is provided by this gap.

These variables are constant over the length of the prisms 14 of Fig. 1A. However, the dimensions may increase or decrease at a constant rate, for example, if the prisms 14 were tapered. An embodiment comprising tapered prisms will be described below with reference to Fig. 8.

Turning now to Fig. 3, there is shown a top view of part of a drive means 11 of the device 10. The drive means 11 includes the base plate 12, which is rotatably mounted on a fixed gear 24. Five spigots 26a-26d and 26f are mounted on the base plate 12, each of the prisms 14a-14d and 14f rotating on a respective spigot. A gear connection assembly 28 includes a planetary gear 30 rotatably mounted on a spigot 32 coupled to the base plate 12.

This is coupled to a crank 34, which is in-turn coupled through a pin 36 and a connecting rod 35 to a second crank 38. The crank 38 carries a gear segment 40, and is coupled to rod

35 through a coupling 42. The gear ratio of the planetary gear 34 to the fixed gear 24 is 3:1, such that the planetary gear 34 rotates three complete times for every pass around the fixed gear 24.

The prism 14e is rotatably coupled to the base plate 12 by a pinion 44, which meshes with the gear segment 40. In this fashion, a 60° rotation of the base plate 12 causes a corresponding rotation of the planetary gear 30 and crank 34, to move the connecting rod 35 laterally, in the direction of the arrow shown, to rotate the second crank 38 and thus the gear segment 40 about a spigot 46, finally rotating the pinion 44 through 190°. Although the pinion moves 190°, the prism coupled thereto moves through 180° due to the use of a lost motion assembly which will be described below with reference to Figs. 6A & B.

The gear connection assembly 28 is shown in Fig. 3 in a position between the two extremes of travel of the pinion 44, after the base plate has moved through 30°. Accordingly, in this position, the prisms 14 are intermediate their first and second display positions.

Referring now to Figs. 4 and 5, further parts of the drive means 11 are shown. Fig. 4 illustrates the assembly without the prisms 14 or the gear connection assembly 28 of Fig. 3, for clarity. The drive means 11 includes a gear mechanism 19 which has a respective gear 48 indirectly coupled to each of the prisms 14. Each gear 48 has respective gear teeth 50, which intermesh with the teeth of an adjacent gear. The gear connection assembly 28 of Fig. 3 and the gears 48 are provided above the base plate 12, and the connection assembly 28 is coupled through the pinion 44 to the gear 48e of the prism 14e. In this fashion, rotation of the base plate 12 acts to directly rotate the prism 14e through 180°.

The intermeshing of the gears 48 acts to rotate adjacent gears 48, and thus corresponding prisms 14, in opposite directions, as illustrated by the arrows in Fig. 4. Accordingly, during movement of the gear segment 40 from one extreme to the other, the first group of prisms 14b, 14d and 14f is rotated in a first direction, whilst the second set 14a, 14c and 14e is rotated in the opposition direction. This provides the movement described above with reference to Figs. 1A-1F, and Fig. 5 shows a device 10 during a rest position such as that illustrated in Fig. 1B.

Figs. 4 and 5 also illustrate a lost motion assembly comprising a number of lost motion devices 52, one associated with a respective prism 14 and gear 48. One of the lost motion devices 52f is shown in the further enlarged view of Fig. 6A and the side view of Fig. 6B. Each lost motion device 52 comprises a lever arm 54 which is coupled to a respective prism 14 in a rigid connection. In addition, each lever arm 54 is rotatably coupled to a respective gear 48 by a spigot 56 and includes a first end 58 defining a first face 60, and a second end 62 defining a second face 64. A shoulder 66 is secured to the gear 48, and a compression spring 68 is mounted between a block 70 on the shoulder 66 and a block 72 on the first end 58 of the lever arm 54. The spring 68 acts to urge the lever arm second face 64 into abutment with a face 74 on the block 66.

As shown in Figs. 4 and 5, the lost motion devices 52 of adjacent prisms 14 are at approximate 180° spacings. During rotation of the prisms 14, the lost motion devices 52 of one of the groups of prisms engages a notched plate 76 on the base plate 12. In Figs. 4 and 5, it is the first group of prisms 14b, 14d and 14f. As shown, the first faces 60 of the

respective lever arms 54 engage detents or notches 78, shown most clearly in Fig. 4.

This firstly ensures that each of the columns do not rotate more that 180° with respect to the base plate 12, so that they remain in alignment in their rest positions. In this fashion, cables for lighting or any other utility can be fed from the base plate 12 to the prisms 14 without the need for special connectors, such as electrical sliprings. In addition, this provides for delay in movement of one of the sets of prisms 14 as described above. This is because each of the lever arms 54b, d and f engage a respective notch 78b, 78d, 78f as shown in Fig. 4. Further travel of the respective gear 48 is thus absorbed by compression of the springs 68 and the opening of a gap 80 between the lever arm second face 64 and the face 74 of shoulder 66. This ensures that when the prisms 14 begin to rotate back in the opposite direction, the prisms 14a, 14c and 14e rotate first a few degrees, whilst the gaps 80b, 80d and 80f are closed, without rotation of the corresponding prisms 14. This ensures that the prisms 14 of opposite groups do not come into contact.

Turning now to Figs. 7A-7C there are shown cross-sectional side and plan views, respectively, of an optional adjustment device, forming part of the gear connection mechanism 28 shown in Fig. 3, and indicated generally by reference numeral 82. The adjustment device 82 allows the effective length of the connecting rod 35 between the pin 36 and the second crank 38 to be adjusted, to in turn vary the degree of rotational motion of the pinion 44, and thus the associated prism 14.

It will be noted that the adjustment device 82 may be alternatively provided between the first crank 34 and the connecting rod 35. The device 82 includes a bearing 84 mounted in a bore 85 in the second crank 38. A pivot 90

includes a shaft 92 rotatably mounted in the bearing 84, and carrying an eccentric circular flange 94 and an adjusting flange 96. Rotating the adjustment flange 96 rotates the eccentric flange 94 to change the length of the connecting rod 35 which is locked in place by a pressure plate 86, retaining screw 88 and washer 89. Alternatively, adjusting the angle of the fixed gear 24 allows the rest positions of the prisms 14 to be made to coincide precisely with the stop positions after each 60° turn of the base plate 12.

Turning now to Fig. 8, there is shown a view similar to Fig. 1A of part of a display device 100, in accordance with an alternative embodiment of the present invention. Like components of the device 100 with the device 10 share the same reference numerals, incremented by 100. The device 100 is similar to the device 10 of Fig. 1A, except the columns 114 are suspended from an upper support plate 112.

Turning now to Fig. 9, there is shown a top view of part of a display device 200, in accordance with a further alternative embodiment of the present invention. The device 200 is similar to the device 10 and like components share the same reference numerals, incremented by 200 and is in a rest position similar to that shown in Fig.1B.

The device 200 includes an alternative drive means 211, which includes a gear mechanism 219. The gear mechanism 219 includes a gear 248 associated with each prism 214. However, each gear 248 is rotatably mounted on spigots 256 on the base plate 212 spaced from the respective prism 214. One of the gears 248 is coupled to a fixed gear (not shown) by a gear connection assembly similar to that shown in Fig. 3, such that when the base plate 212 is rotated, the gear 248f is rotated, to in turn rotate each of the other gears 248.

The gears 248 are coupled to the prisms 214 by co-operating first and second off-centre gears in the form of a first elliptical drive gear 97 and a second elliptical follower gear 98, which replace the lost motion devices 52 of the device 10. The first elliptical drive gears 97 are mounted off-centre on the spigots 256 and mesh with the respective second elliptical follower gears 98, which are mounted off-centre on spigots 99 coupled to the prisms 214. The first elliptical gears 97 are rotated together with the respective gear 248, to transfer rotation through the second elliptical gears 98 to the respective prisms 214. The prisms 214 are mounted on the respective spigots 99 at a position spaced from a centre of the column.

In the rest position of the prisms 214 shown in Fig. 9, adjacent pairs of elliptical gears 97, 98 are at extreme opposite ends of their travel. For example, the first and second gears 97f, 98f are at opposite ends of travel from the first and second adjacent gears 97a, 98a. The first elliptical gear 97f is thus in a position where the radial length defined between the spigot 256f and the second elliptical gear 98f is at its smallest. In comparison, the radial length defined between the spigot 256a and the second gear 98a is at its greatest.

Accordingly, when the base plate 212 is rotated as described above, the outer prisms 214b, d and f initially rotate at a lower rotational velocity than the inner prisms 214a, c and e. As the prisms 214b, d and f approach the end of their travel, they begin to rotate at a higher rotational velocity than the prisms 214a, c and e due to the off-centre mounting of the elliptical gears 97, 98. This motion avoids any contact between the prisms 214; provides a relatively smooth motion; provides good reliability in operation; affords the potential to operate at high rotational velocities; the structure

involves relatively few components and is relatively easy to assemble. It will be understood that the relative rotational velocities of the prisms 214 at the start and end of a rotation sequence can be varied by changing relative gear ratios of the elliptical drive and follower gears 97, 98. Taking a factor K to be the ratio between the greatest and the smallest radial length of the elliptical gears 97 or 98, theoretically, K should be greater than 1.36 to allow each display prism to move without interference with an adjacent display prism 214 at the start or end of each cycle. Likewise, K should typically be less than 1.5, depending on the size of the chamfer 18, to avoid a mid-cycle collision between chamfer 18 and an adjacent display prism. A typical value for K is 1.45 and thus variations in the value K affect the relative rotational velocities of the prisms 214.

Figs. 10 and 11 illustrate further alternative embodiments of the present invention, indicated generally by reference numerals 300 and 400, respectively. Like components with the device 10 share the same numerals incremented by 300 and 400, respectively. Each of the devices 300 and 400 are similar to the device 10 of Fig. 1A, or the device 200 of Fig. 9, except the device 300 of Fig. 10 includes eight columns 314 defining two sets of four visible display surfaces 316. Fig. 10 shows four such surfaces 316a-d. Also, the gear ratio of the planetary gear to the fixed gear (not shown) of the device 300 is 4:1, such that the planetary gear rotates four complete times for every pass around the fixed gear. The device 400 of Fig. 11 includes ten prisms 414 and defines two sets of five visible display surfaces 416, five such surfaces 416a-e shown. In a similar fashion to the device 300, the gear ratio of the planetary gear to the fixed gear (not shown) of the device 400 is 5:1, such that the planetary gear rotates five complete times for every pass around the fixed gear.

Various modifications may be made to the foregoing without departing from the scope of the present invention.

CLAIMS

1. A three dimensional display device comprising:

a support member;

a plurality of display elements coupled to the support member, the display elements together defining a plurality of display surfaces, each display surface presenting a visible display in use; and

drive means for moving the display elements between at least first and second display positions;

whereby, in use, at least two display surfaces are visible, and whereby the drive means moves the display elements to change the display surfaces which are visible.

2. A display device as claimed in claim 1, wherein, in use, the display elements together define a combined display on each display surface.

3. A display device as claimed in claim 1, wherein, in use, the display elements each define a separate, independent display on each display surface of which they form part.

4. A display device as claimed in any preceding claim, wherein each display element includes at least three display faces.

5. A display device as claimed in any preceding claim, comprising six display elements which, in use, together define six display surfaces.

6. A display device as claimed in any one of claims 1 to 4, comprising eight display elements which, in use, together define eight display surfaces.

7. A display device as claimed in any one of claims 1 to 4, comprising ten display elements which, in use, together define ten display surfaces.

8. A display device as claimed in any preceding claim, wherein the display device comprises first and second groups of display elements, each group comprising at least three display elements and each group of display elements being rotatable between the first and second display positions in opposite directions to one another.

9. A display device as claimed in any preceding claim, wherein each display element is rotatably coupled to the support member by a pivot, each pivot coupled to a respective display element off centre from a main axis of the display element.

10. A display device as claimed in any preceding claim, wherein the display elements comprise generally elongate columns.

11. A display device as claimed in claim 10, wherein the display elements comprise triangular prisms.

12. A display device as claimed in any preceding claim, wherein the display elements taper along a main length thereof.

13. A display device as claimed in any preceding claim, wherein the support member defines a lower support with the display elements mounted thereon.

14. A display device as claimed in any one of claims 1 to 12, wherein the support member defines an upper support with the display elements suspended therefrom.

15. A display device as claimed in any one of claims 1 to 12, wherein the display device further comprises first and second support members, one of the first and second support members forming an upper support and the other one of the first and second members a lower support, with the display elements rotatably mounted therebetween.

16. A display device as claimed in any preceding claim, wherein the support member comprises a rotatable plate.

17. A display device as claimed in any one of claims 1 to 12, wherein the device is orientated on its side, whereby said display elements are mounted horizontally.

18. A display device as claimed in any preceding claim, wherein the drive means further comprises a gear mechanism adapted to rotate selected ones of the display elements in opposite directions to the remainder of the display elements.

19. A display device as claimed in claim 18, wherein the gear mechanism comprises a main gear coupled to each display element, the main gears intermeshed such that rotation of a selected one of the display elements rotates all of the display elements.

20. A display device as claimed in any preceding claim, wherein the gear mechanism includes a drive connection assembly coupled between the support member and one of the display elements.

21. A display device as claimed in any preceding claim, wherein the drive means further comprises a fixed gear to which the support member is rotatably coupled and a planetary gear mounted on the support member for rotation around the fixed gear together with the support member.

22. A display device as claimed in claim 22, wherein the gear ratio of the planetary gear with respect to the fixed gear is between 3:1 and 5:1.

23. A display device as claimed in either of claims 21 or 22, wherein the display element driven by the drive connection assembly includes a pinion coupled to and rotated by the planetary gear.

24. A display device as claimed in any one of claims 20 to 23, wherein the drive connection assembly further comprises a crank, connecting rod and associated gear segment coupled to a display element.

25. A display device as claimed in claim 24, wherein the gear segment is adapted to rotate the display element through approximately 180° between extremes of travel.

26. A display device as claimed in any preceding claim, wherein the drive means further comprises an adjustment device for adjusting the degree of rotation of the display elements.

27. A display device as claimed in any preceding claim, wherein the drive means is adapted to rotate the display elements at variable rotational velocities.

28. A display device as claimed in claim 27, wherein the drive means is adapted to initially rotate selected ones of the display elements at a rotational velocity greater than adjacent display elements.

29. A display device as claimed in either of claims 27 or 28, wherein the drive means further comprises first and second co-operating off-centre gears mounted for rotation about off-

centre pivots, one of the first and second off-centre gears coupled to respective display elements, the other off-centre gears adapted for rotation to drive the off-centre gears coupled to the display element.

30. A display device as claimed in claim 29, wherein the first and second off-centre gears of adjacent display elements are out of phase.

31. A display device as claimed in any one of claims 1 to 26, wherein the drive means is adapted to rotate selected ones of the display elements with a time delay over the remainder of the display elements.

32. A display device as claimed in claim 31, wherein the drive means further comprises a lost motion device coupled to each display element, the lost motion devices absorbing at least part of the rotational motion of the respective display element at an end of its travel.

33. A display device as claimed in claim 32, wherein each lost motion device comprises a biased lever arm coupled to a respective display element and adapted to engage a detent of the support member at an end of its rotational travel.

34. A display device as claimed in claim 32, wherein the detent comprises a notch in the support member, one notch for each lever arm of the respective lost motion devices.

35. A display device as claimed in either of claims 33 or 34, wherein the lever arm includes a first end having a first face adapted to engage a respective detent and a second end having a second face adapted to abut a restraint.

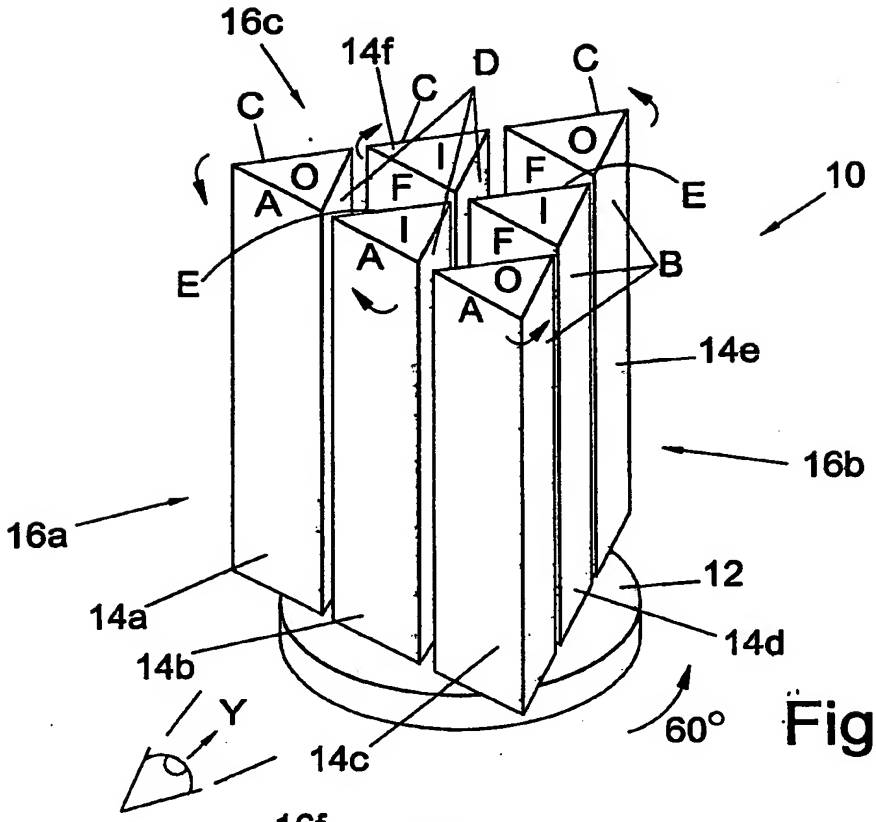
36. A display device as claimed in claim 35, wherein a gap is defined between the second face and the restraint, the dimensions of said gap defining the degree of lost motion.

37. A display device as claimed in either of claims 35 or 36, wherein the restraint comprises a shoulder and wherein a spring is provided between the shoulder and the first end of the lever arm, to bias the lever arm into engagement with the detent.

38. A display device comprising:

a support member; and

a plurality of display elements mounted on the support member, the display elements being rotatable between a first display position, where the display elements define a first set of at least three visible display surfaces, and at least a second display position, where the display elements define a second set of at least three visible display surfaces and means for translating the display elements between said first and second positions.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14d
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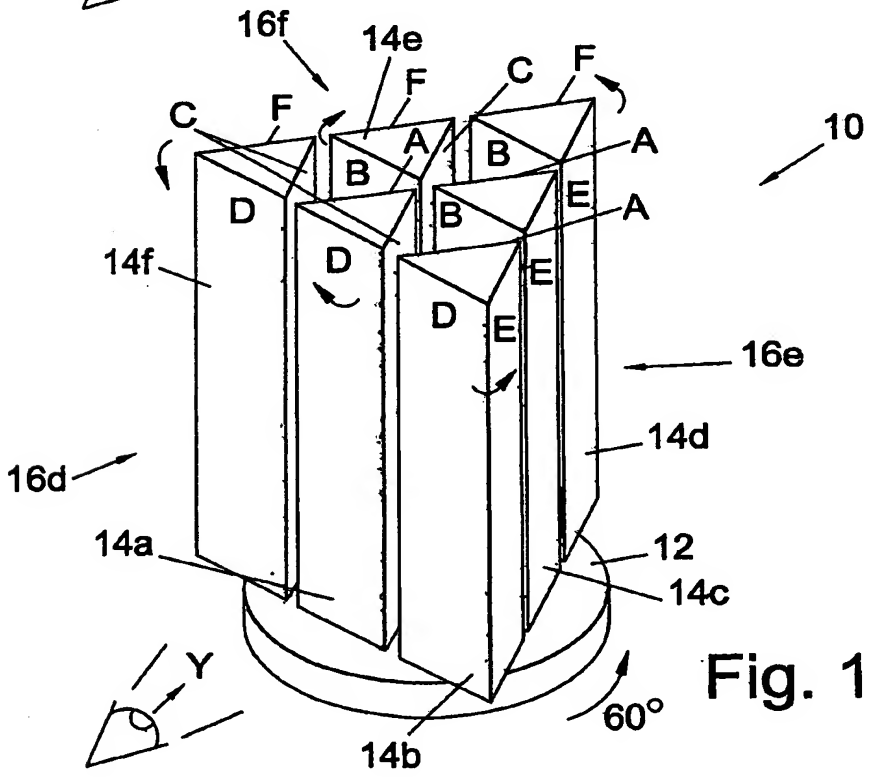
60°
14c

Fig. 1A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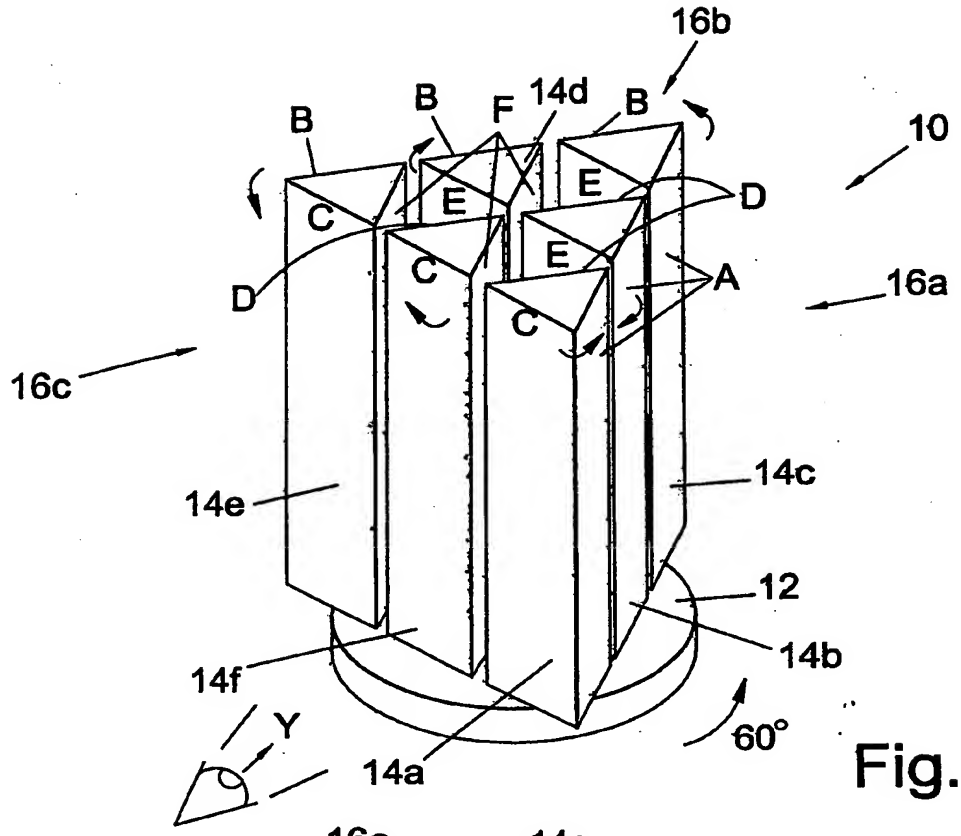
12
14c
Y
60°
14b

Fig. 1B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14f
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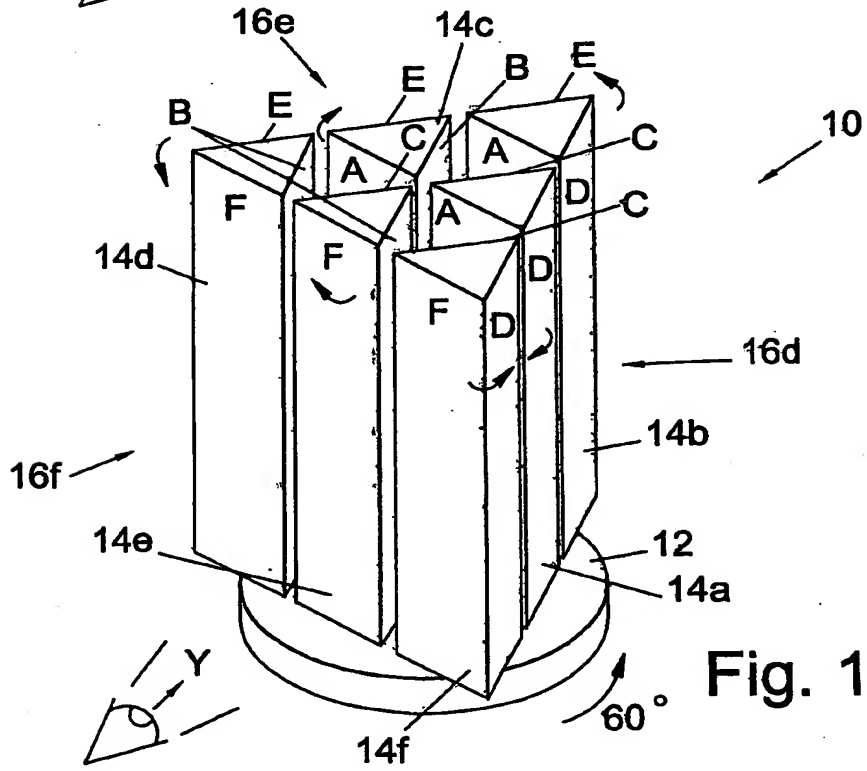
14a

Fig. 1C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14f

Fig. 1D

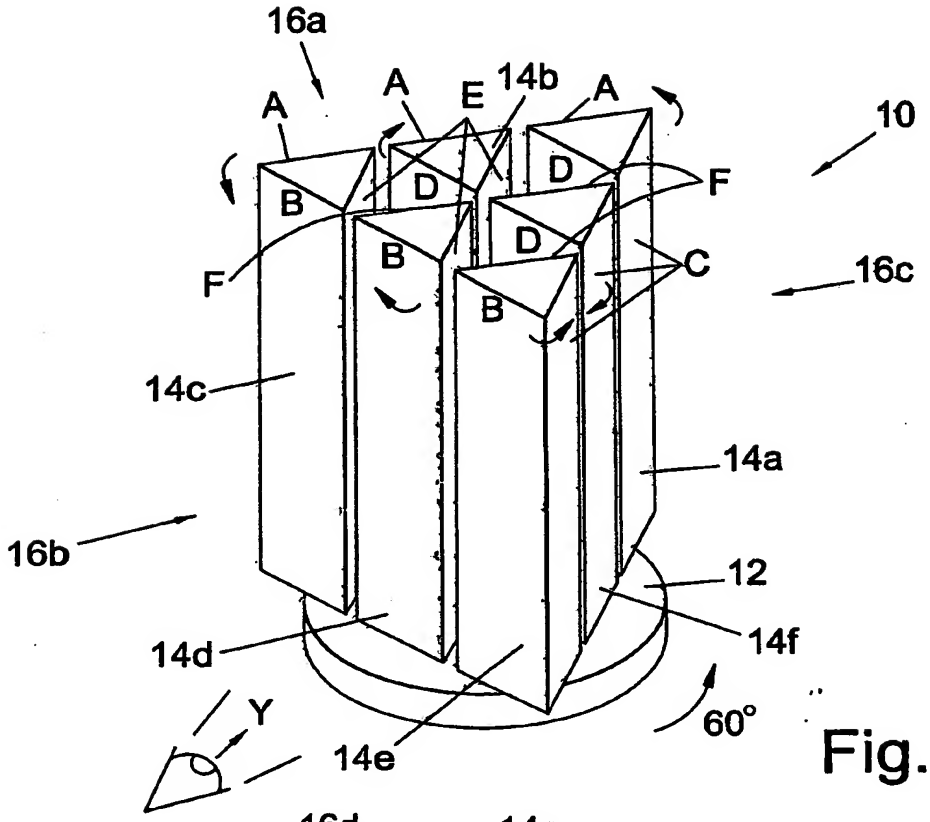
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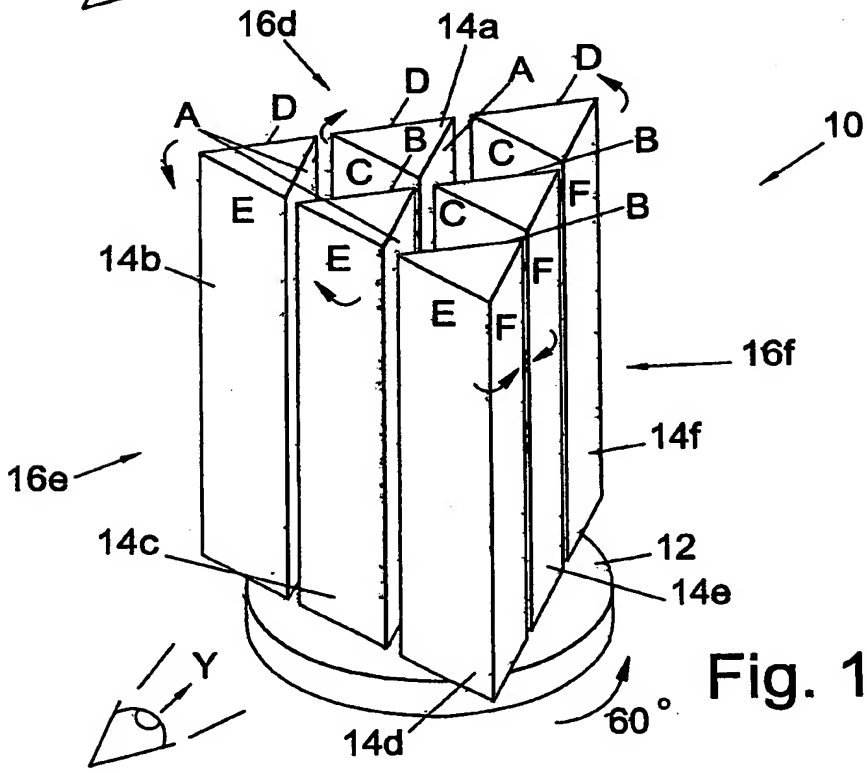
Fig. 1E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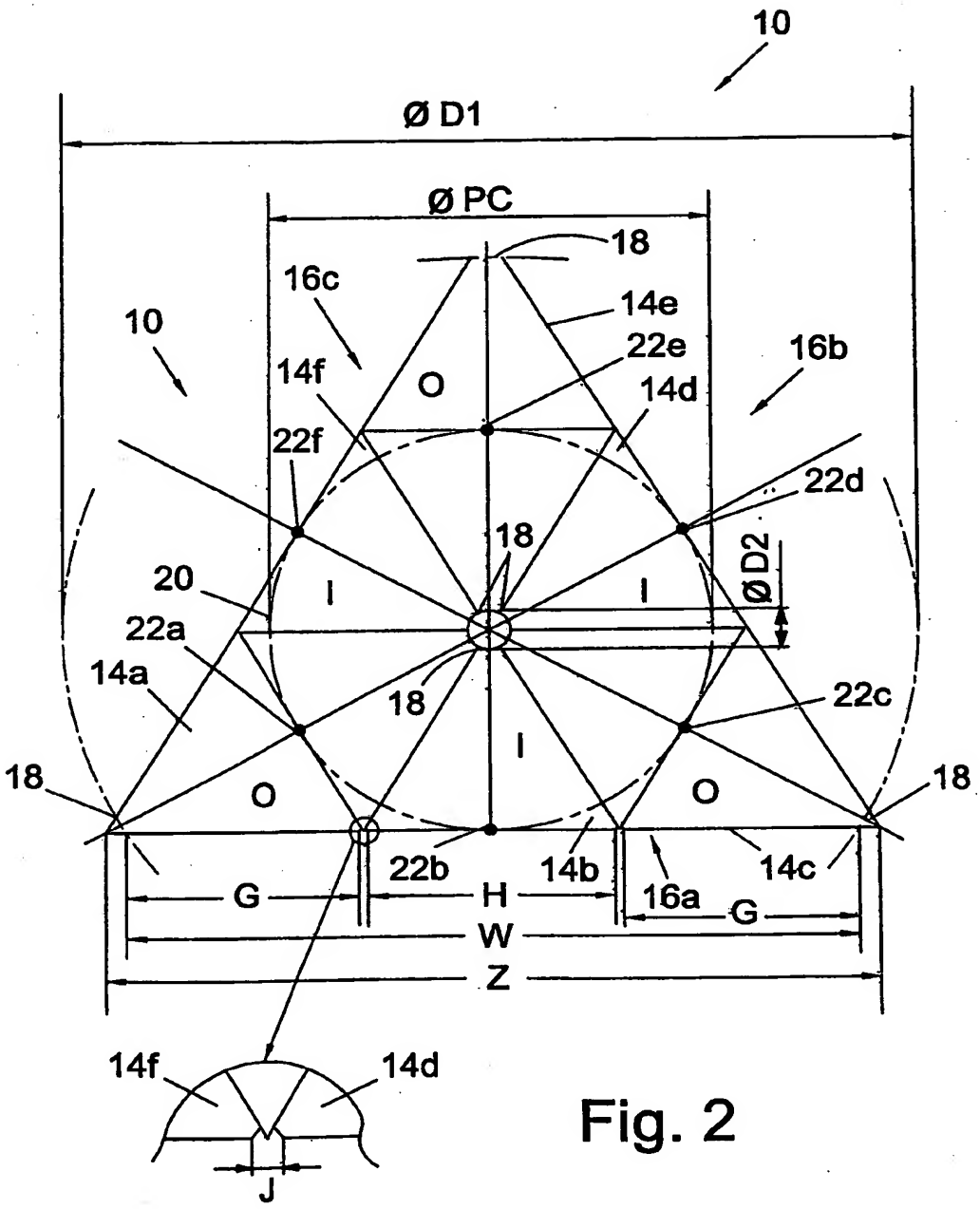
14d

Fig. 1F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14d
J

Fig. 2

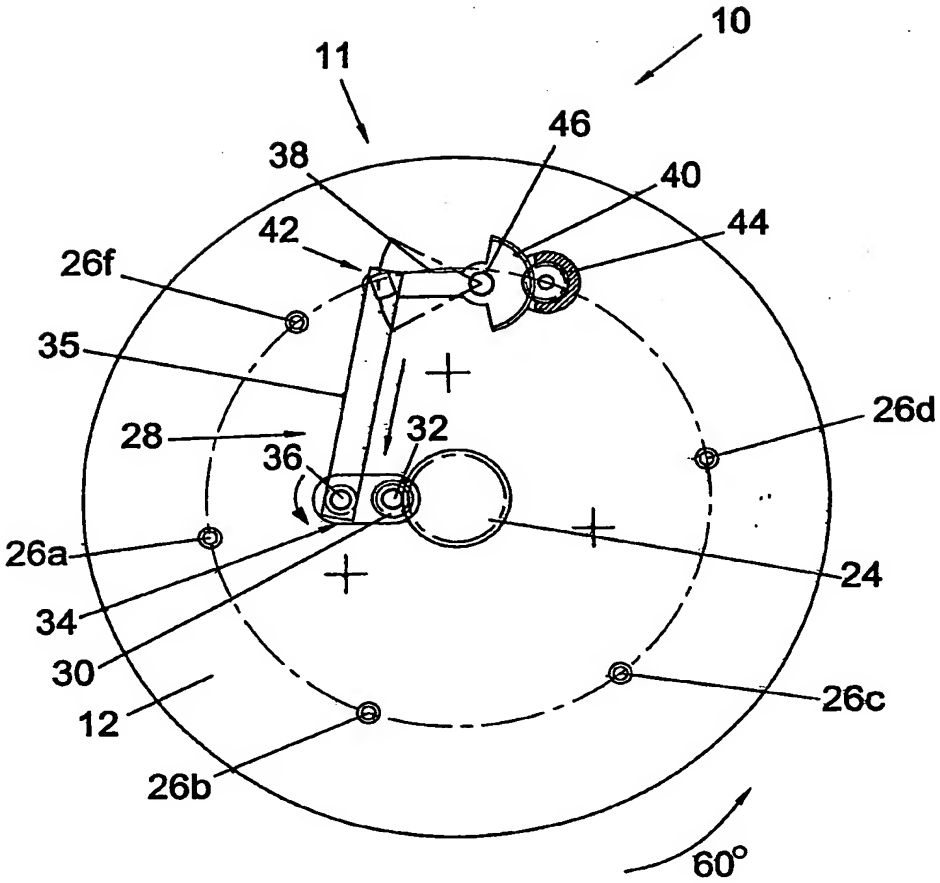

Fig. 3

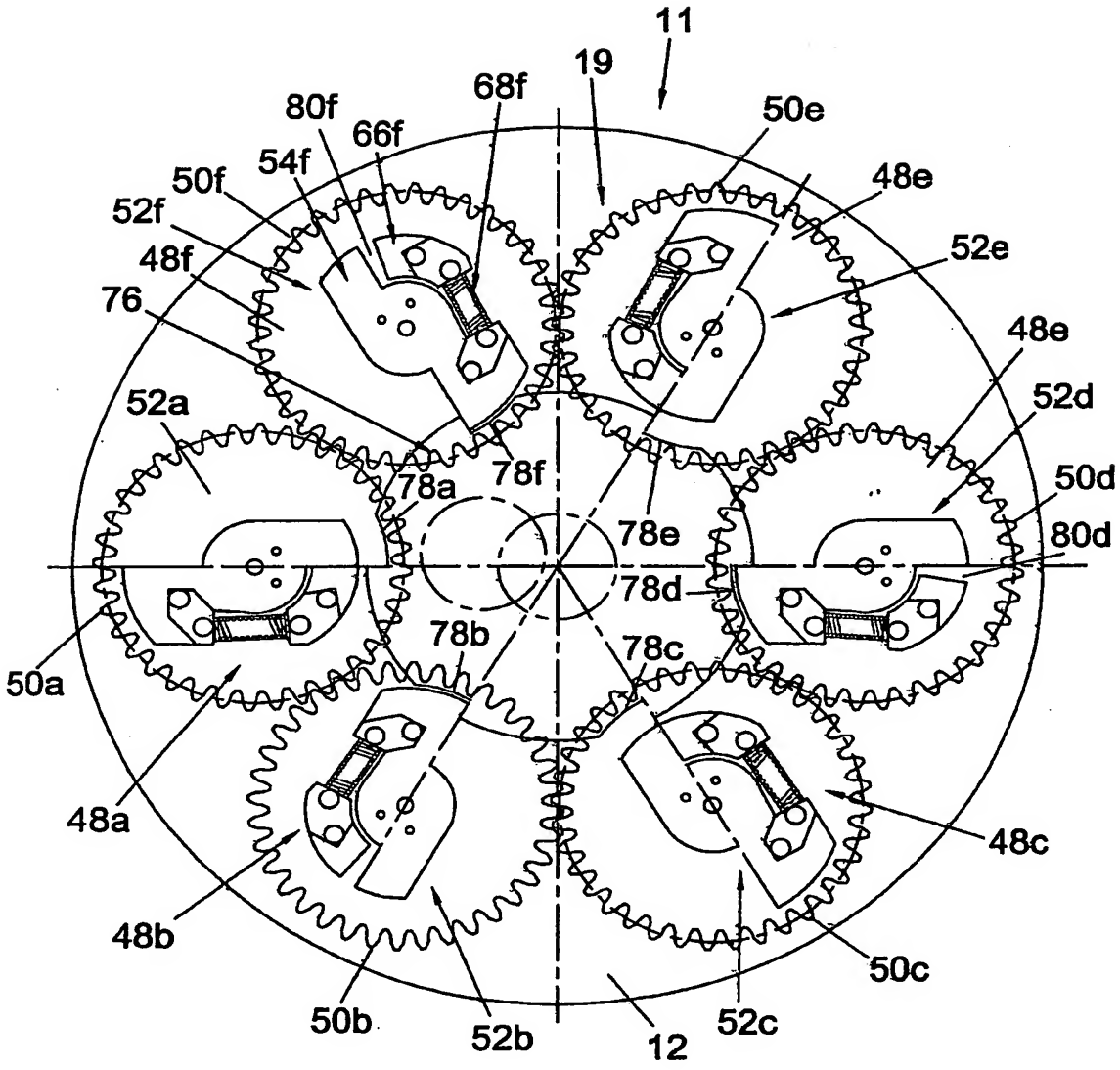
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Fig. 4

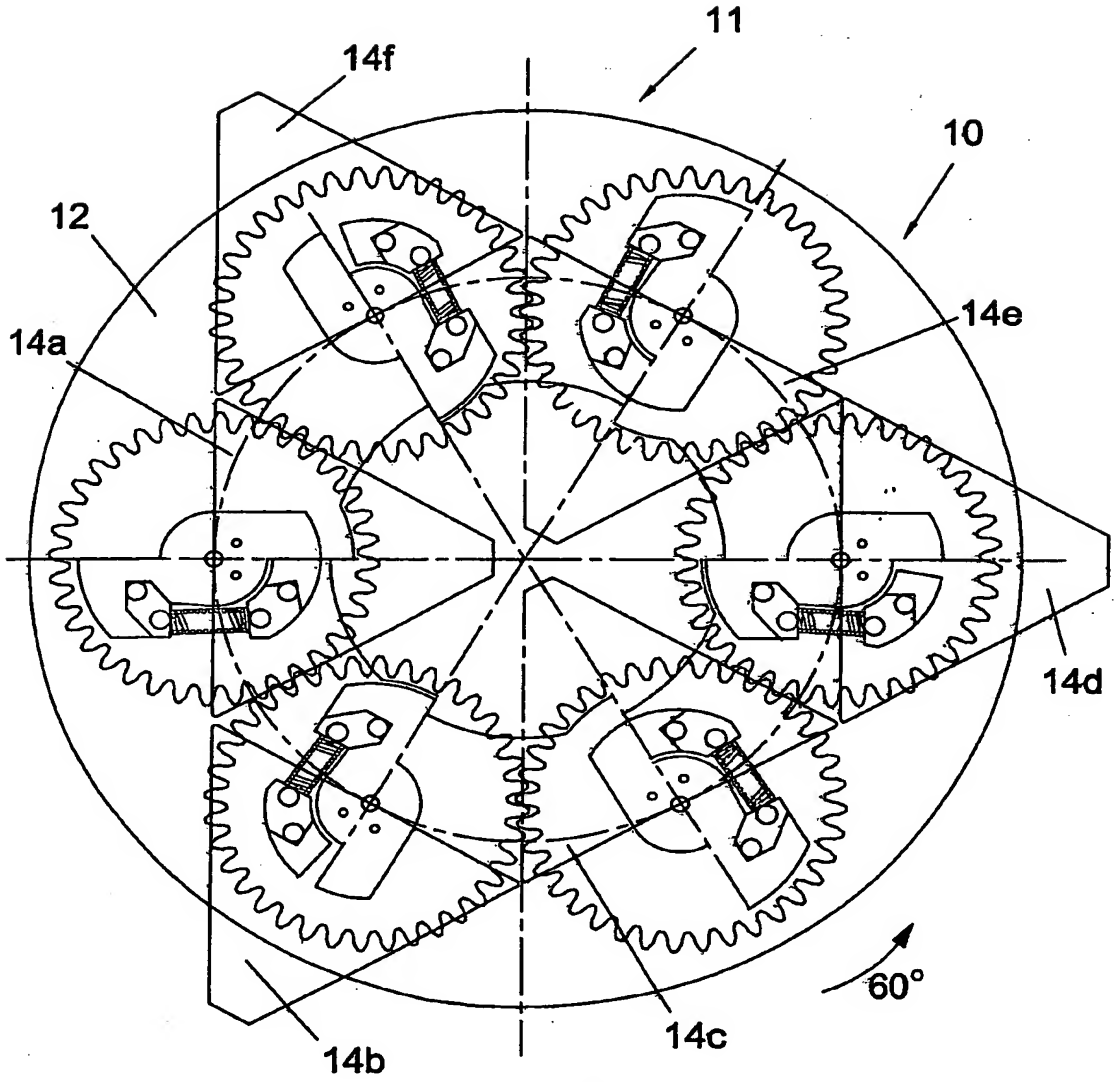

Fig. 5

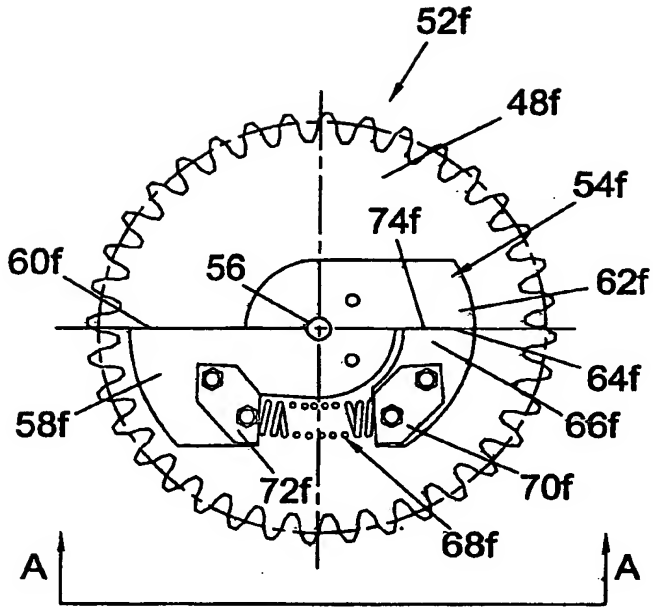
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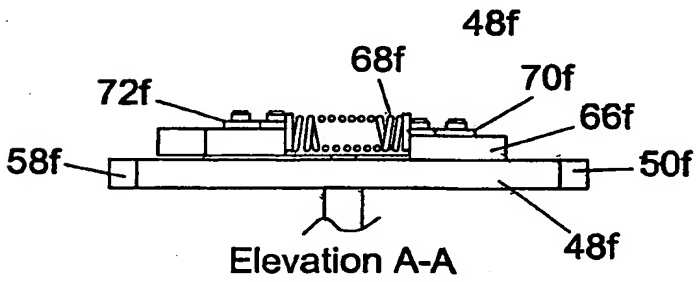
Fig. 6A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Elevation A-A

Fig. 6B

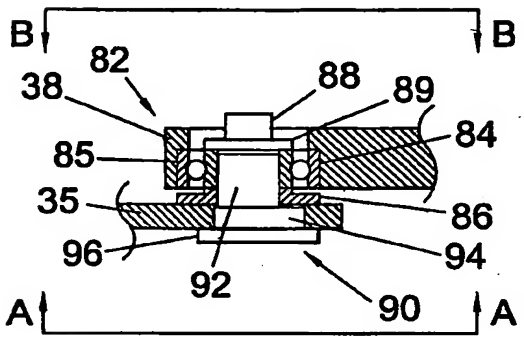
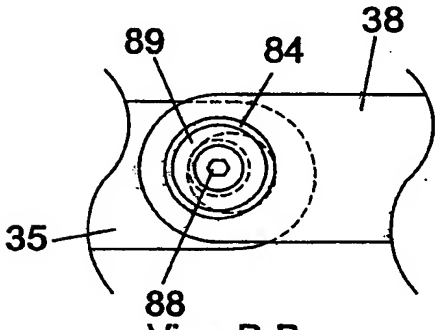
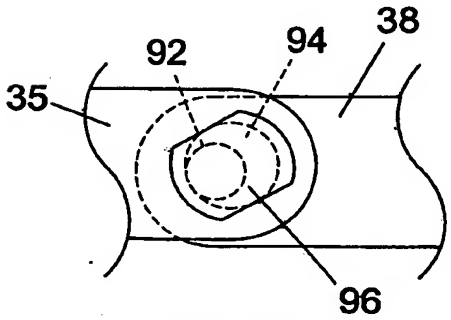


Fig. 7A



View B-B

Fig. 7B



View A-A

Fig. 7C

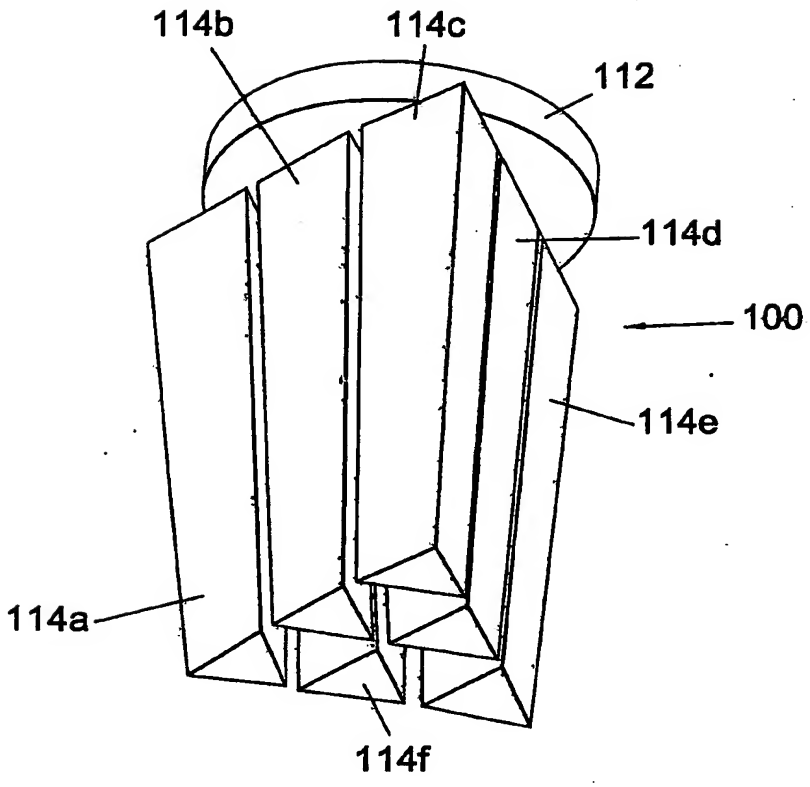


Fig. 8

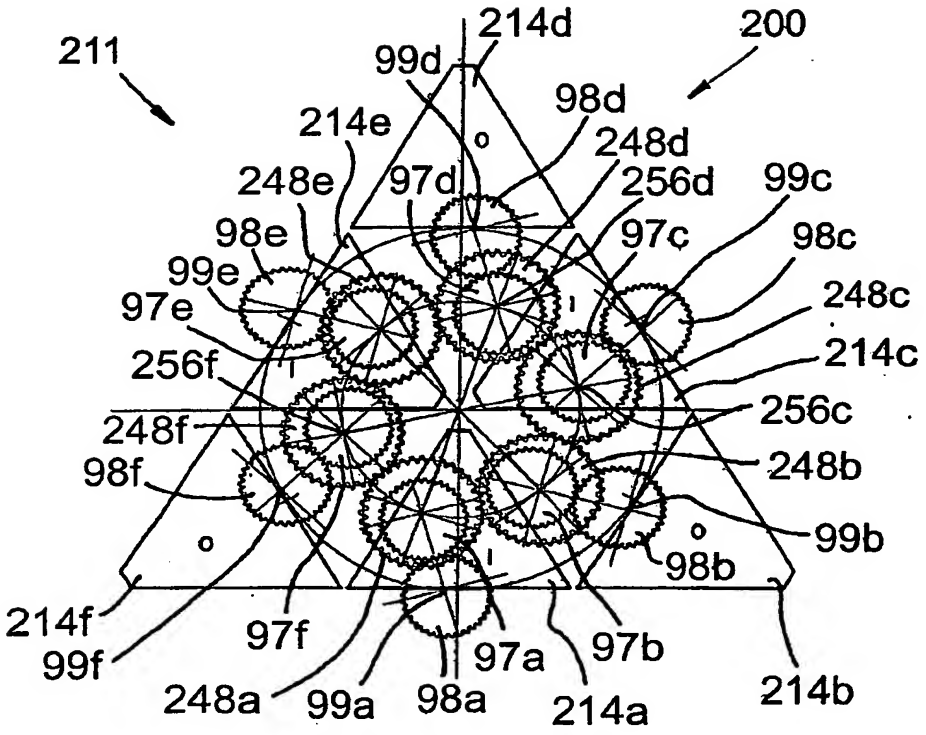

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Fig. 9

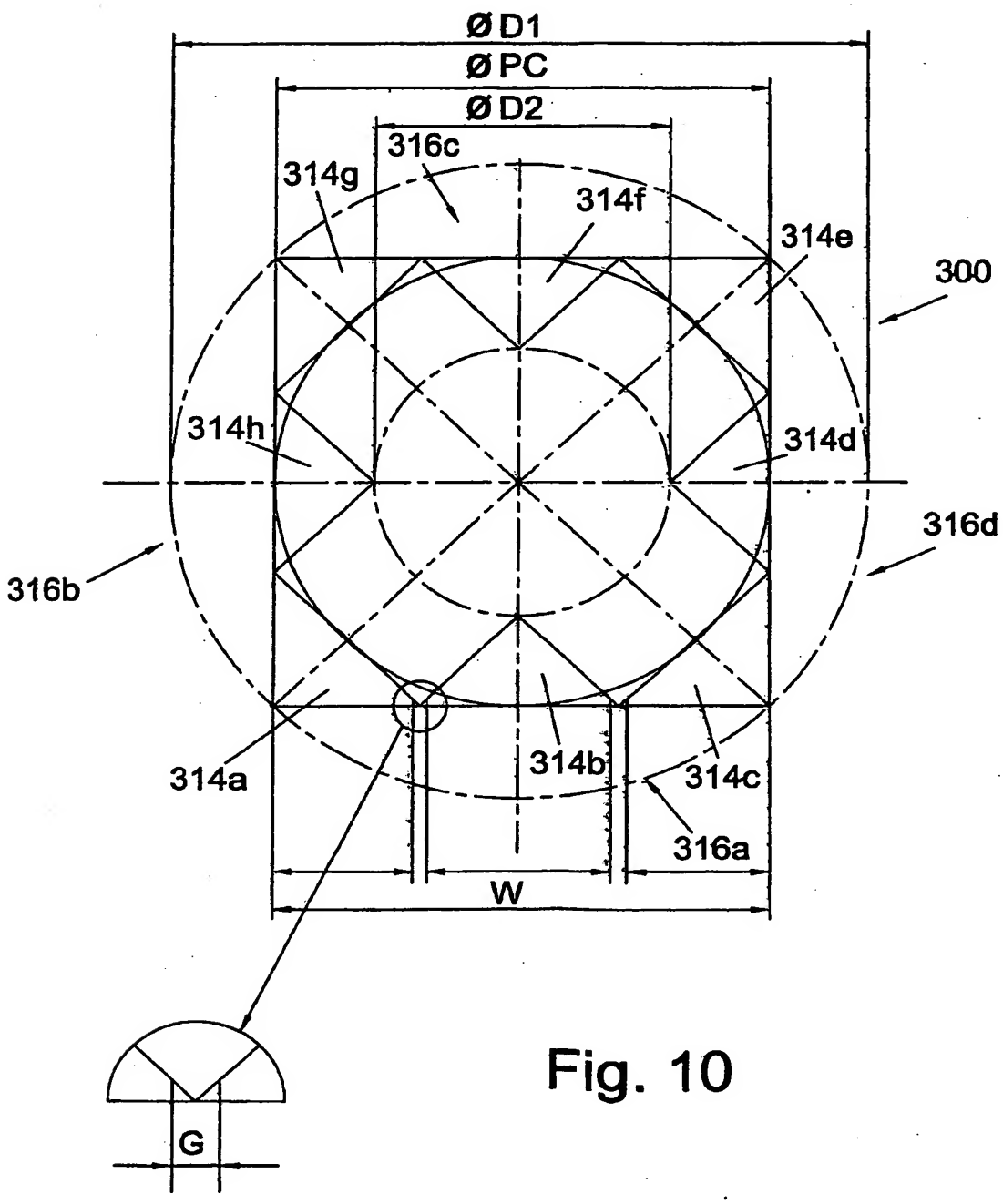
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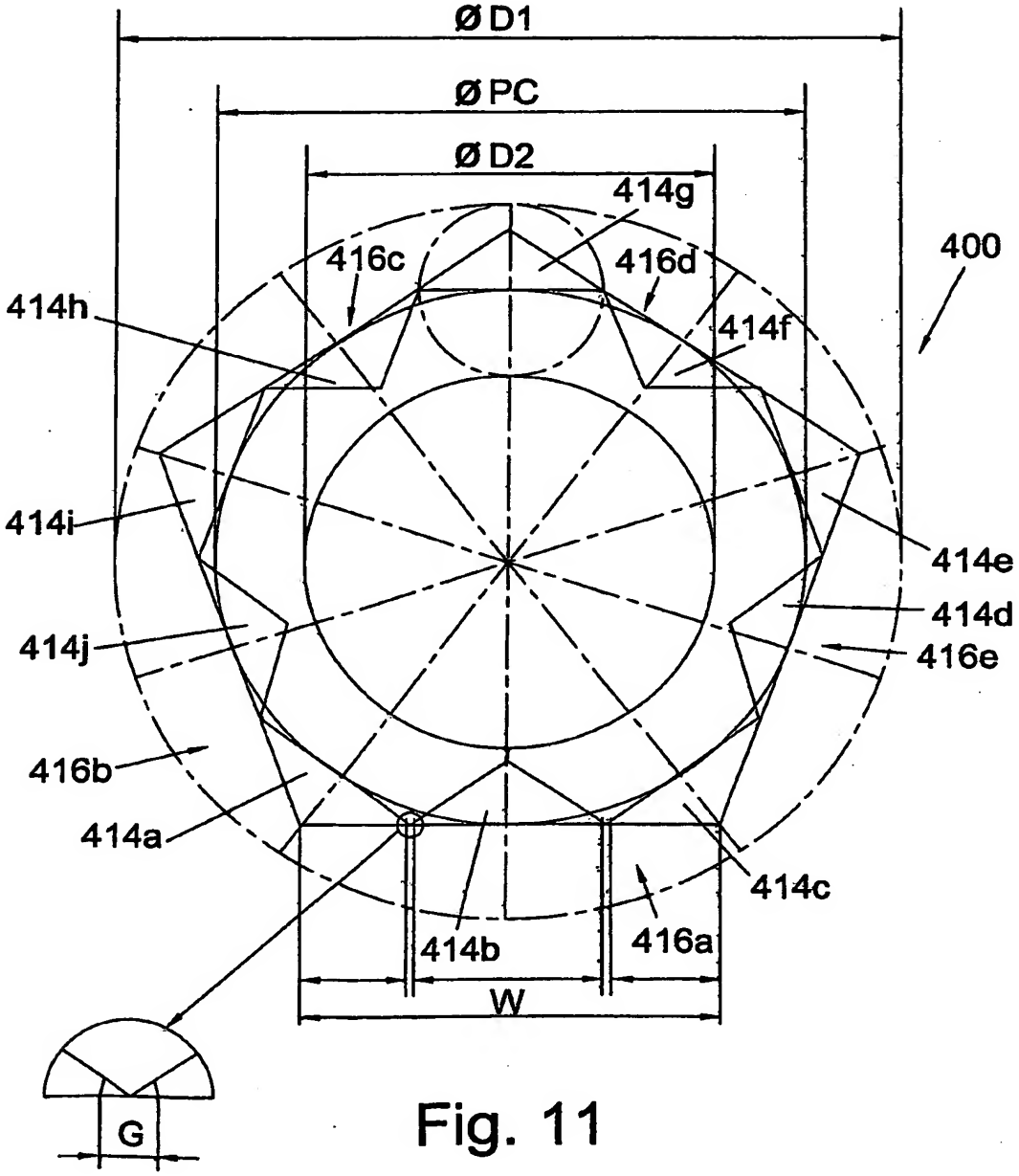
Fig. 10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G

Fig. 11

INTERNATIONAL SEARCH REPORT

Inten al Application No
PCT/GB 02/04956

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G09F11/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 297 353 A (GHALAYINI FAOUZI M) 29 March 1994 (1994-03-29) column 3, line 47 -column 7, line 63	1-4, 8-16,20 17, 26-28,31
X	WO 00 36579 A (KOREM AHARON) 22 June 2000 (2000-06-22) page 5, line 8 -page 10, line 17	1-4, 8-16,20, 21,23
Y	US 5 562 459 A (DURLACH DAVID M) 8 October 1996 (1996-10-08) figure 8 abstract column 4, line 38 -column 6, line 60	17, 26-28,31
A	DE 669 463 C (PETER SECKLMANN) 28 December 1938 (1938-12-28)	

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 March 2003	03/04/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bertin, M

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INTERNATIONAL SEARCH REPORT

Int[illegible]nal Application No
PCT/GB 02/04956

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CH 614 064 A (UTIGER EDWIN) 31 October 1979 (1979-10-31)	

INTERNATIONAL SEARCH REPORT

Inter al Application No
PCT/GB 02/04956

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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WO 0036579	A	22-06-2000	AU	1583200 A	03-07-2000
			WO	0036579 A1	22-06-2000
US 5562459	A	08-10-1996	NONE		
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CH 614064	A	31-10-1979	CH	614064 A5	31-10-1979